



Sustainable solar power
High efficiency solutions for solar energy
applications

Every hour, the earth absorbs more solar energy than the world's population consumes in a year.





Unlimited clean energy with zero emissions

By converting solar energy into electrical energy, for each kWh generated, carbon dioxide (CO₂) emissions that pollute the planet can be reduced by 600 grams.

Solar energy is clean, unlimited and safe. Even when it is converted into electricity through photovoltaic or thermodynamic plants, it does not produce harmful emissions.

That is why this renewable energy source has assumed a key role in the future of energy policy. Many governments started incentive plans to promote generation and integration of energy into the grid by means that minimize the environmental impact.

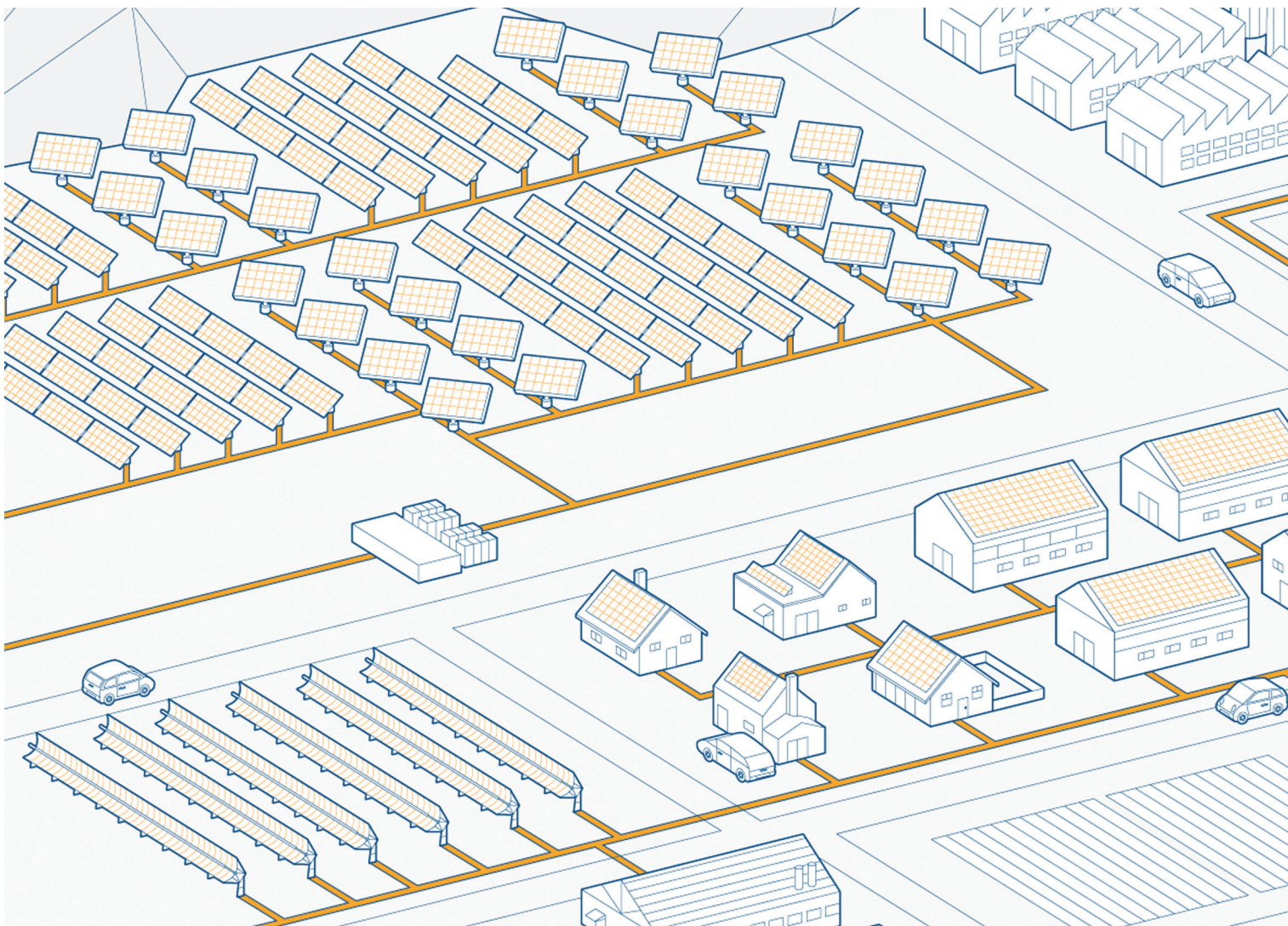
Utilities, banks, capital ventures and other players investing on solar power generation face a common challenge: capturing solar energy, a natural and unlimited source of heat and light, through solutions that can efficiently transform it into reliable and profitable electricity.

ABB, longstanding expertise squeezing the sun's power

With its extensive experience in all sectors of energy and its comprehensive range of products, ABB is a qualified supplier of devices and systems for applications in the field of alternative and renewable energy.

ABB has been a leading player in the solar power industry since the early 1990s when we developed an automation platform for the world's first test facility for concentrating solar power technologies at the Plataforma Solar de Almería (PSA) in Spain.

Since then, we have been involved at a pioneering stage in just about every type of photovoltaic (PV) and concentrating solar power (CSP) technology developed, be it in Europe, North America, Australia, North Africa or the Middle East. This has given us a unique expertise in how best to harness, control and store solar energy and efficiently convert it into reliable electricity, ready for transfer into the local grid. ABB's portfolio of products, systems and solutions for the solar power industry is extensive. It ranges from turnkey photovoltaic power plants to complete power and automation solutions for CSP plants and for commercial, industrial and residential rooftop PV installations. On the manufacturing side,



The advantages of working with a global leader

ABB supplies robots and robot-based systems for solar panel factories, and electrical, control and instrumentation solutions for silicon processing factories, the material that is used to make solar cells.

And in smart grids, ABB is at the forefront in developing the technologies and solutions that will make possible the electrical transmission and distribution systems of the future. These systems will integrate traditional types of large-scale, centralized power generation with small-scale, localized types of renewable energy like solar and wind, creating a single optimized network with multi-directional power flows and real-time grid monitoring and market mechanisms.

Quality and sustainability, our key factors

For every activity and every product family, ABB is highly focused on environmental sustainability and safety.

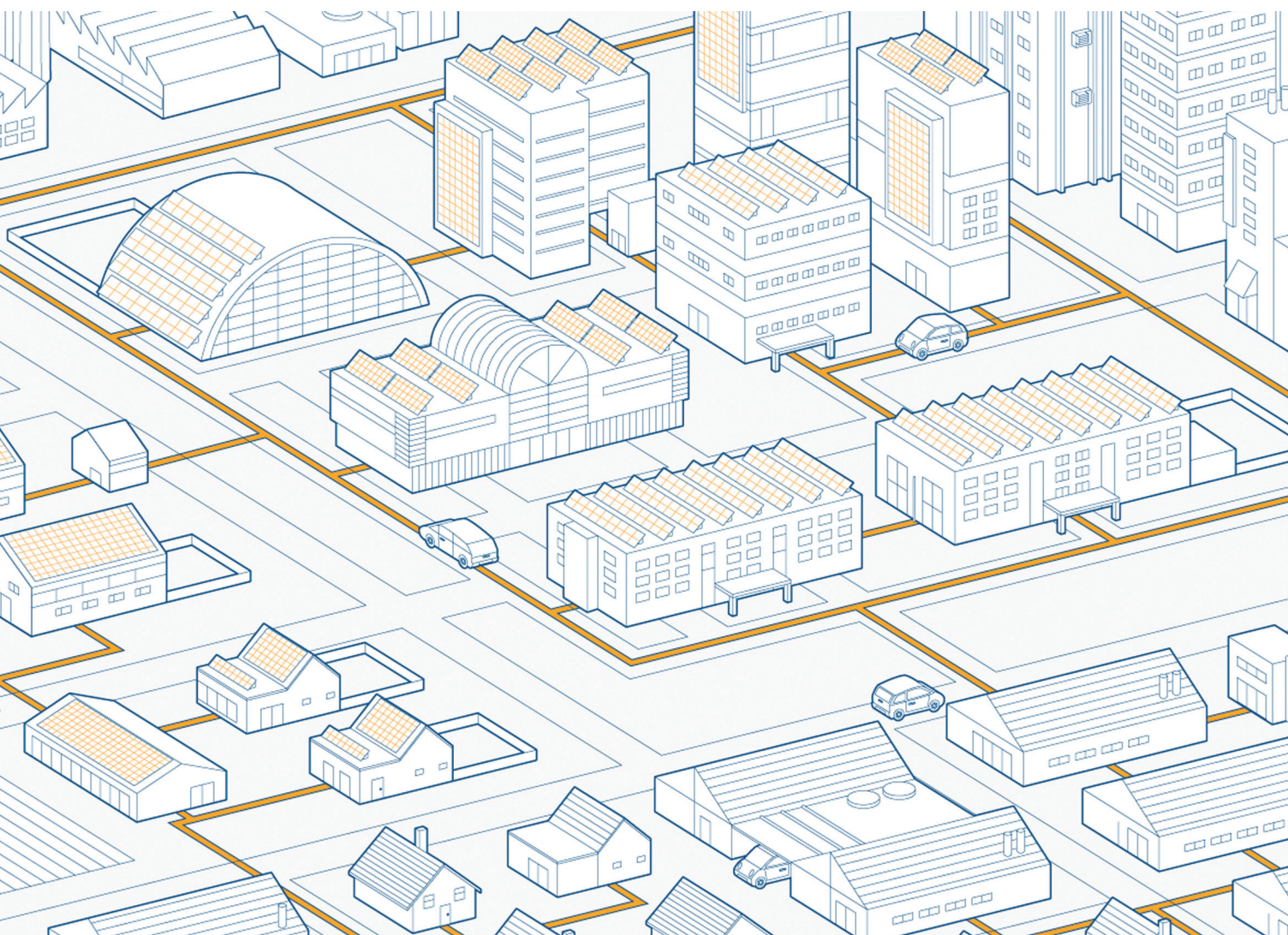
The environmental management systems, certified to ISO 14001, cover most of ABB operations and its products

comply with the main international European and North-American standards.

The development of eco-compatible products, not containing any substances that can endanger or harm the environment, is imperative in all the R&D activities of ABB.

The reliability and efficiency of a plant depend on many factors, related both to the entire plant and to the functional details of the single subsystems and items of equipment. The quality and safety of each product are essential to guarantee the maximum performance of the plants.

The more complex a plant, the more profitable it is to turn to an experienced partner, capable of providing global solutions to respond substantially and effectively to all the needs of each single application, from design to maintenance. ABB, a global leader in the automation and energy industry for years, can support its clients in building large-sized plants, financed on the basis of the reliability and soundness of the supplier companies.



Photovoltaic plants

From turnkey solutions...

ABB solutions for photovoltaic (PV) power plants are designed to maximize plant performance and provide owners with a rapid return on investment and a long plant operating life.

Our scope of supply covers the entire project from site and project assessment to plant design, engineering, installation, commissioning, service and maintenance. It includes all plant electrical and control equipment, which is highly optimized to meet the requirements of PV solar power applications.

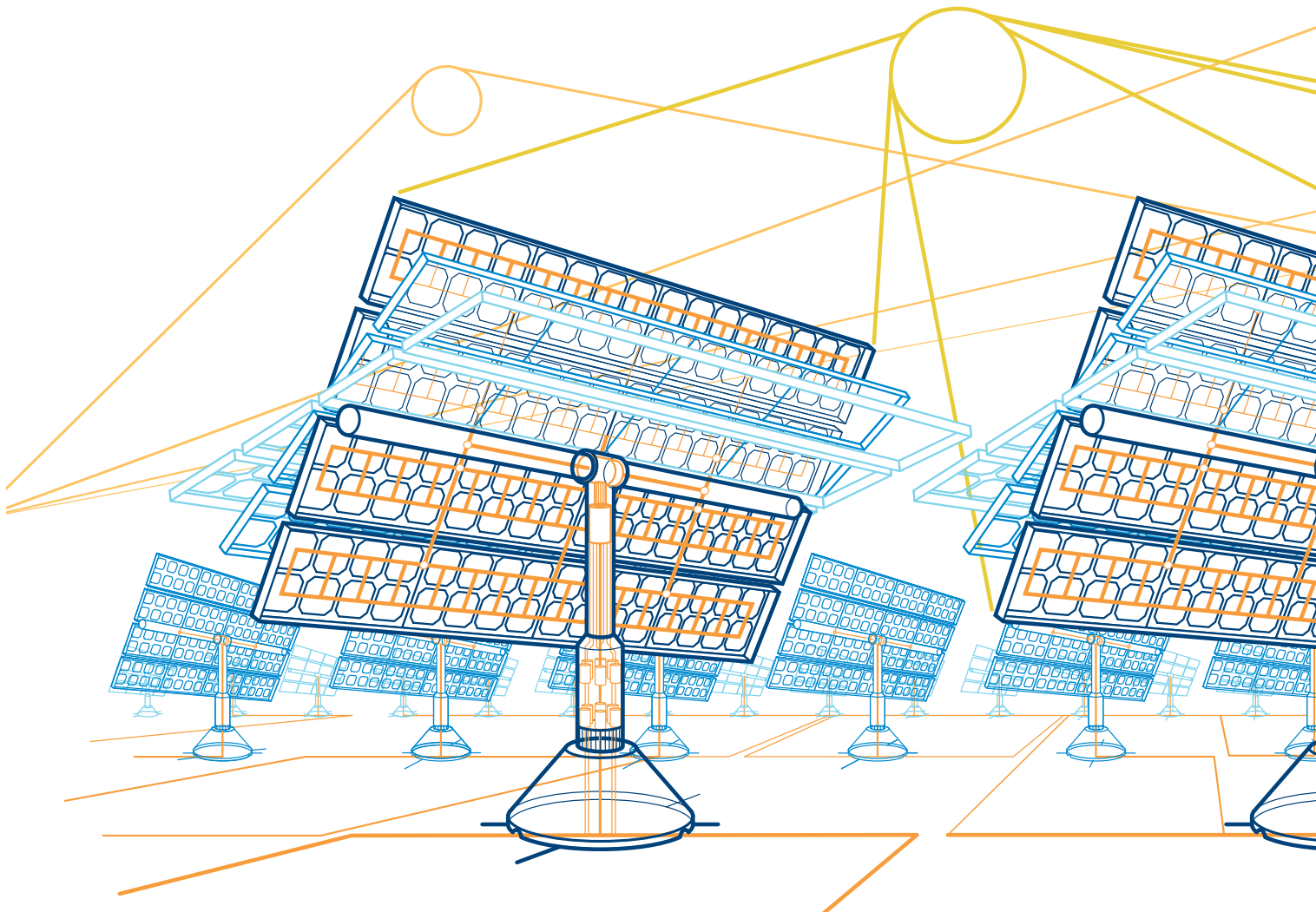
The result is a solution that generates around 15 percent more energy than conventional alternatives.

One partner, one solution

ABB has developed a standard modular concept for photovoltaic power plants. It is our 'one partner, one solution' answer to the needs of customers operating in the global PV market.

Each part of the solution – trackers, inverters, transformers, control system, etc – is delivered in pre-tested 1 MW modules for scalability, cost efficiency and rapid installation. Whether the plant has a capacity of 1 MW or 20 MW, the modules are easy to integrate and the solution is repeatable at any site and in any country.

ABB, in partnership with contracted manufacturers, offers a complete range of solar trackers – of all types and all materials. All other products and systems are made by ABB and are designed for the special requirements of PV plants and the demands of a high-performance modular solution.



Optimization – the key to productivity

Optimization is a prime differentiator in the ABB solution. It enables the plant to achieve the highest levels of power delivery and energy efficiency.

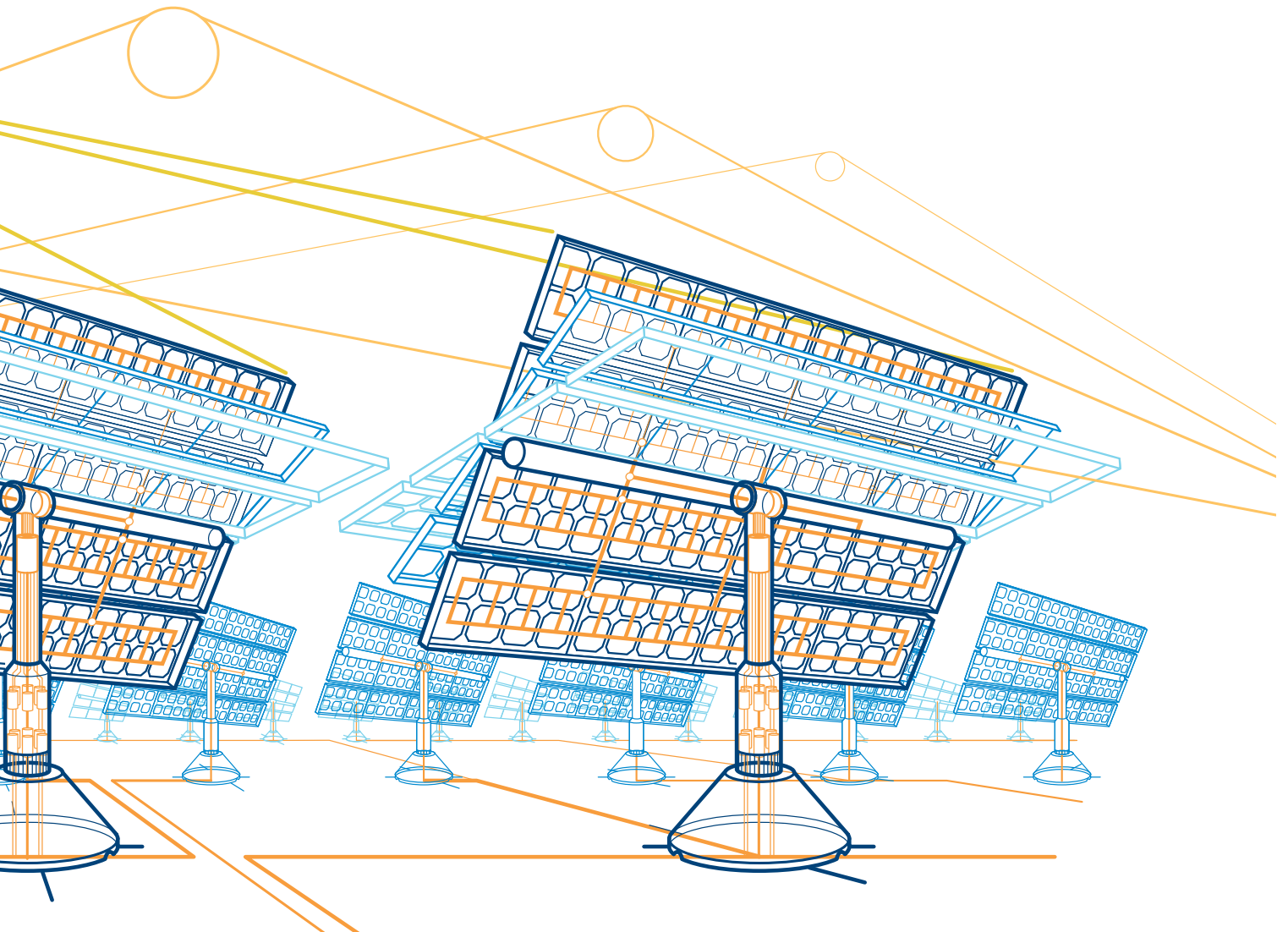
Each ABB module is engineered for the latest generation of solar applications and includes innovations like a uniquely efficient automatic switching system, a new family of high-efficiency inverters, highly accurate and robust controllers, and small brake motors and frequency converters, that are tailored to meet the needs of the solar industry - hot, dry places - and are designed to withstand tough conditions to minimize life time costs. These products included in our modules enable the trackers to harness more energy from the sun. The result is a standard modular solution that in installations to date produces around 15 percent more energy than comparable alternatives.

Getting it right from the start

ABB offers its customers a number of unique tools to determine the optimal solution for any given site.

Based on powerful ABB algorithms, these tools include an automatic PV power calculation assistant that calculates the optimal layout and generating capacity for a site, an automatic budget calculation tool that computes the cost and revenues of the project by taking into account all conceivable variables, and an automatic return on investment tool that calculates the payback time of the proposed investment.

Together, these tools enable the customer to get the project right from the start and to know what lies ahead in the way of costs, revenues and returns.



Photovoltaic plants

...to high efficiency products

ABB is a market and technology leader in power and automation products, from transformers, switchgear and circuit breakers to motors, drives, power electronics and robots, to name but a few.

Not surprisingly, those same products that make up ABB solutions for photovoltaic power plants and rooftop PV installations are also the products of choice for system integrators and engineering, procurement and construction companies (EPCs) the world over.

Each product has been optimized for PV applications, to generate maximum energy reliably, safely and – for those products in the field - in all operating conditions.

Powerful solar inverters - the heart of the power plant

ABB's range of central inverters is designed specifically for large-scale PV power plants and rooftop installations in industrial and commercial buildings.

Based on ABB's highly successful platform of industrial drives - the most widely used industrial drives on the market – the inverters are the most efficient and cost-effective way to convert the direct current generated by solar modules into high-quality and CO₂-free alternating current that can be fed into the power network.

ABB central inverters have a high efficiency level. Optimized and accurate system control and a maximum power point tracking (MPPT) algorithm ensure that maximum energy is delivered to the power network from the solar modules. Of compact and modular design, the inverters are easy to install and maintain. Power factor compensation is standard to meet grid codes and avoid additional cost.

Safe, reliable and energy-efficient transformers

ABB is the market and technology leader in transformers, offering a full range of dry type transformers for a broad range of applications. Dry-type transformers are the optimal solution for photovoltaic plants. They are self-extinguishing and explosion-proof, do not leak pollutants or fire hazardous substances, are made of ultra-durable materials for a long service life, and can operate safely in the toughest climates and geological conditions.



To these product strengths ABB has recently added a unique level of energy efficiency. ABB's new range of EcoDry™ product range of ultra-efficient dry-type transformers reduces low-load losses by as much as 70 percent and high-load losses by 30 percent, compared to international energy conservation standards.

Medium voltage and high voltage products

ABB offer a complete range of medium voltage and high voltage products such as switchgear, fuses, apparatus, cables or connectors needed in main transformation centre and the distribution centre of the PV plant. The ABB global leadership and long experience in medium voltage and high voltage electrical installations guarantee that our products offer the maximum electrical safety for the plant and the staff, while ensuring the minimal loss of energy.

Energy-efficient variable speed drives for solar trackers

Motorized solar trackers use electric motors and gear reducers to turn the panel. Adding an ABB variable speed drive to the solar tracker provides a soft-start function for the motor, resulting in smoother rotation and reduced mechanical wear, thereby lowering maintenance costs.

By eliminating high starting currents and mechanical shocks through the soft-start feature, the drive extends the life of the system compared to direct on-line motor starting methods. The AC drive consumes only the power needed to turn the panel, thereby keeping the motor at peak energy efficiency.

This all-electric system eliminates the need for fluid, hoses, pressure gauges and other equipment required by hydraulic systems.

ABB drives easily integrate the special functions that protect the trackers in extreme weather conditions, thereby reducing the need for an external control system. Other drive options include a variety of fieldbus interfaces for easy remote diagnostics of the system; as well as drive configuration tools that copy the tracker parameters into the drive in seconds, resulting in substantial time savings for solar power plants with hundreds or thousands of trackers.

High-quality low voltage components

An accurate selection of components determines the success of the whole photovoltaic system. These components play a key role in ensuring that people and buildings connected to the system are properly protected, and that there is maximum production of energy over the years.

From an economic point of view, it is even more important for each individual component in a photovoltaic system to be selected on the basis of the warranties provided by the manufacturer than it is for a normal electric system. This is because the operating specifications of each device must remain unchanged throughout the entire lifecycle of the system. ABB offers a wide range of low voltage components fully designed to comply with these warranties and lifecycle specifications required by photovoltaic systems, whether small, medium or large installations.



Thermosolar plants

Controlling the plant, connecting to the grid

ABB provides complete power and automation solutions for all the main concentrating solar power (CSP) technologies – parabolic trough, power towers, integrated solar combined cycle, heliostat solar concentrators, Stirling solar dish systems, combined solar-biomass and others.

Our scope of supply ranges from patented high-precision programmable logic controllers for the thousands of parabolic troughs, dishes or collectors in the solar field to control systems for thermal storage tanks, electrical balance of plant for the power block, and electrical equipment that feeds the power reliably into the local power grid.

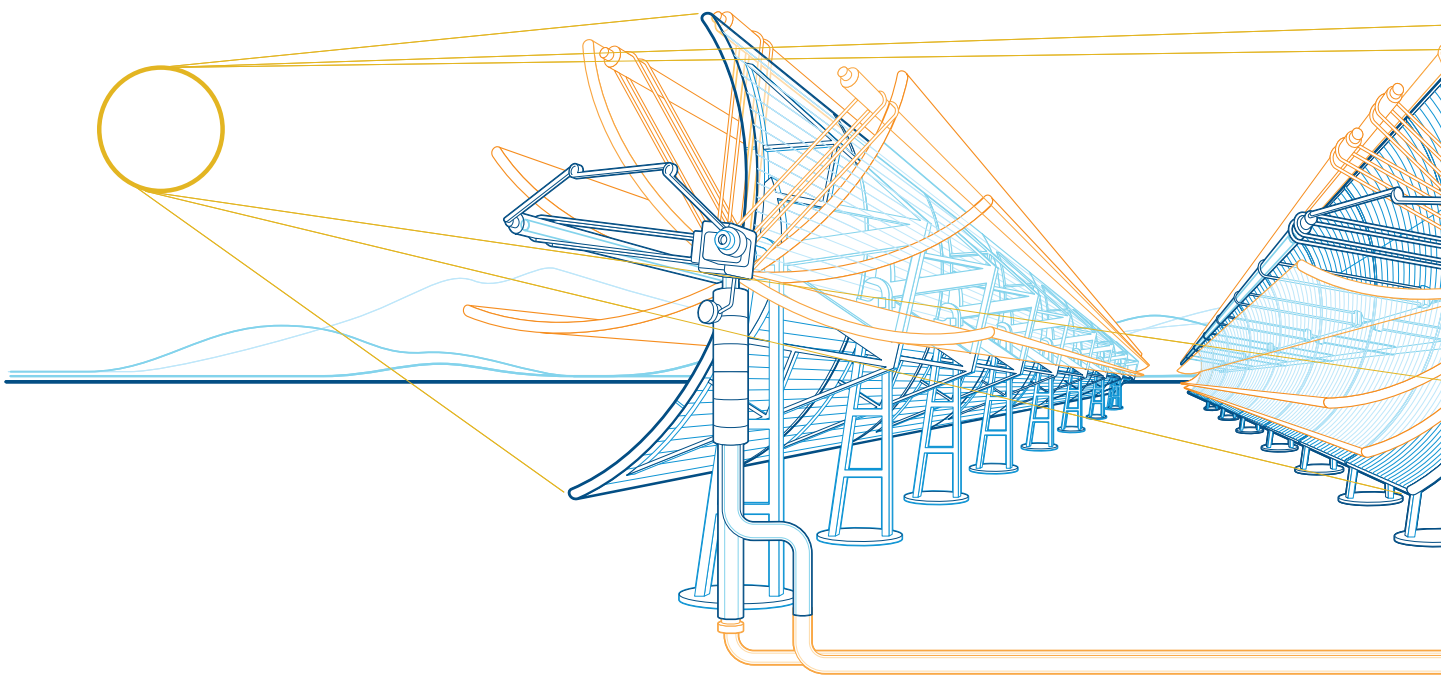
ABB's capability in CSP encompasses the entire project chain and includes design, engineering, erection, installation, commissioning, service and maintenance.

Patented precision control of solar tracking systems

ABB has developed and patented a programmable logic controller (PLC) cabinet with relays and low-voltage switchgear that enables the collectors to capture maximum energy with unparalleled accuracy. Exceptionally robust, the cabinets are designed to withstand extreme environments of intense heat and cold, as well as dust, erosion and the mechanical stress caused by the collector moving every few seconds. The AC500 PLC uses high-precision solar algorithms to ensure that the collectors are precisely aligned and follow the movement of the sun with exceptional accuracy. This, together with the easy-to-use ABB library for solar thermal plants and the unique scalability of the AC500, makes the solution equally accurate for all types of solar tracking systems. The AC500 performs all control tasks linked to open and closed loops, monitors the tracking of the sun, and includes options like:

- Calculating the path of the sun
- Registering and assessing the sensors connected (anemometers, pyranometer, etc.)
- Placing the panels in a safe position if weather conditions deteriorate
- Manual positioning mode
- Remote data transmission

ABB motors and variable speed drives enable the trackers to perform the movements determined by the PLCs with minimal energy consumption; and ABB low voltage switchgear makes the entire tracking system safe and reliable by protecting it from lightning and overvoltage.



Delivering the energy from the field to the turbines

The concentrated energy captured by the collectors is absorbed by heat transfer fluid (usually oil) flowing through tubes in the solar field. ABB instrumentation and control systems ensure that the fluid is kept within the required process parameters. Effective and reliable medium and low voltage motors combined with drives powering pumps circulate fluid, water and steam keeping operating costs low while ABB's generators maximize electricity production and revenue. ABB designs and manufactures a wide range of motors: AC and DC, induction and synchronous, for hazardous and non-hazardous areas. Over one century of experience enables ABB to adapt the motor designs to any application in the solar industry where high efficiency, reliability and low life time costs are requested.

Reliable, efficient electric generation

Solar power production sets special demands on the electric generator. The generator needs to manage the fact that an installation often has limited water supply, is located in severe hot environments, is connected to a sometimes weak network and is operated over a broad load spectrum. Further, the limitation of solar radiation as a source often requires electric generators in solar installations to be started daily. These requirements are not new to ABB; we have long experience in providing optimized generators for installations in severe environments ensuring highest revenue and plant profitability. ABB generators can be driven with single as well as a double shaft ends, which can be an advantage during operation with large load variations or for continuous power production, using for example one gas turbine and one steam turbine.

Thermal storage doubles productivity

By storing energy captured during the day in large tanks of molten salt it is possible to increase plant productivity, enabling the turbines to generate power during the night or on days when the sun is not shining. ABB provides automation systems that control the tanks and ensure that the molten salt is kept within critical process parameters, thereby preventing the salt from crystallizing and the contents, tanks and process equipment being destroyed.

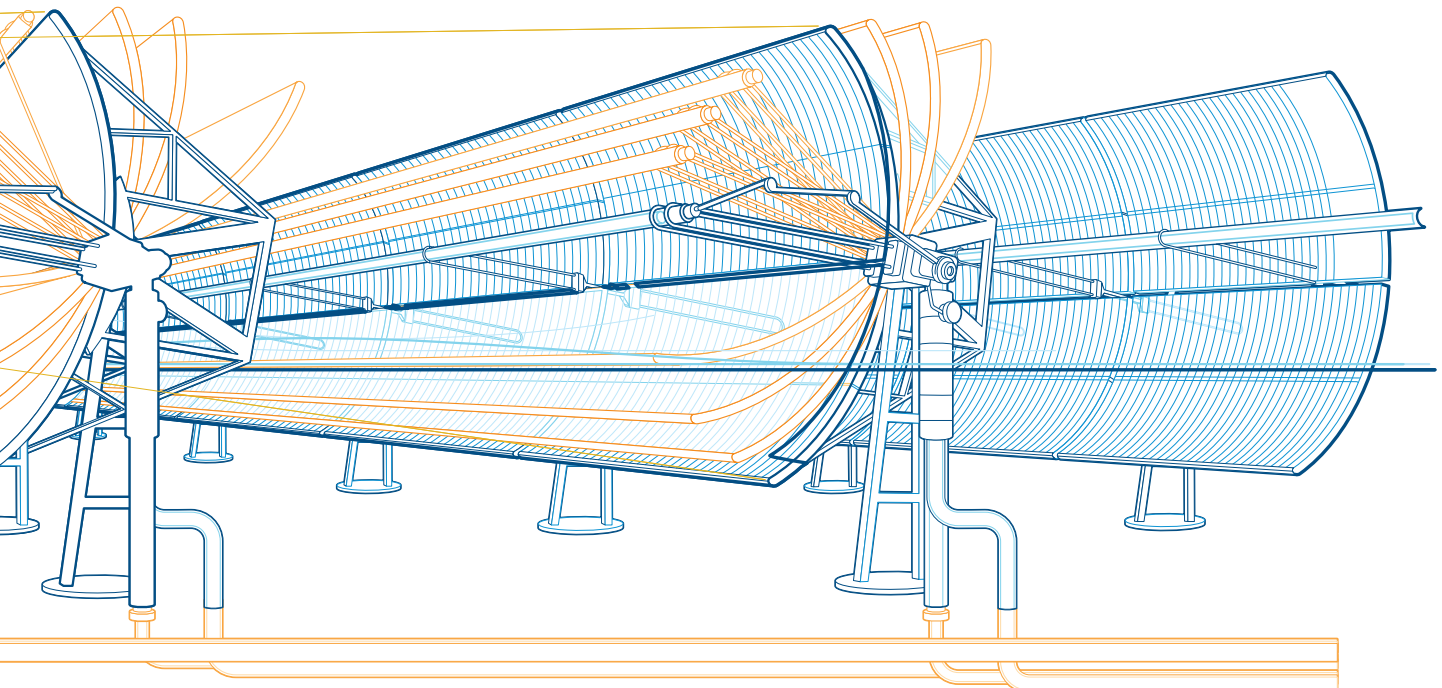
Controlling and energizing the power plant

As one of the world's leading suppliers of power and automation solutions for power generation facilities, ABB provides complete packages of integrated instrumentation, control and electrical equipment to automate and energize the power plant.

An ABB System 800xA extended automation system can integrate the entire facility – solar field, thermal storage tanks and power block – into a single control, operations and engineering environment. By providing plant-wide visibility and real-time information in a uniform way to the right people at the right time, System 800xA brings measurable improvements to operator efficiency and plant performance.

Feeding clean energy into the grid

From compact to large substation solutions, high-efficiency transformers to static var compensators with energy storage systems, our product portfolio and technology capability makes ABB the ideal partner to connect renewable sources of energy to the grid at the highest levels of reliability and safety.



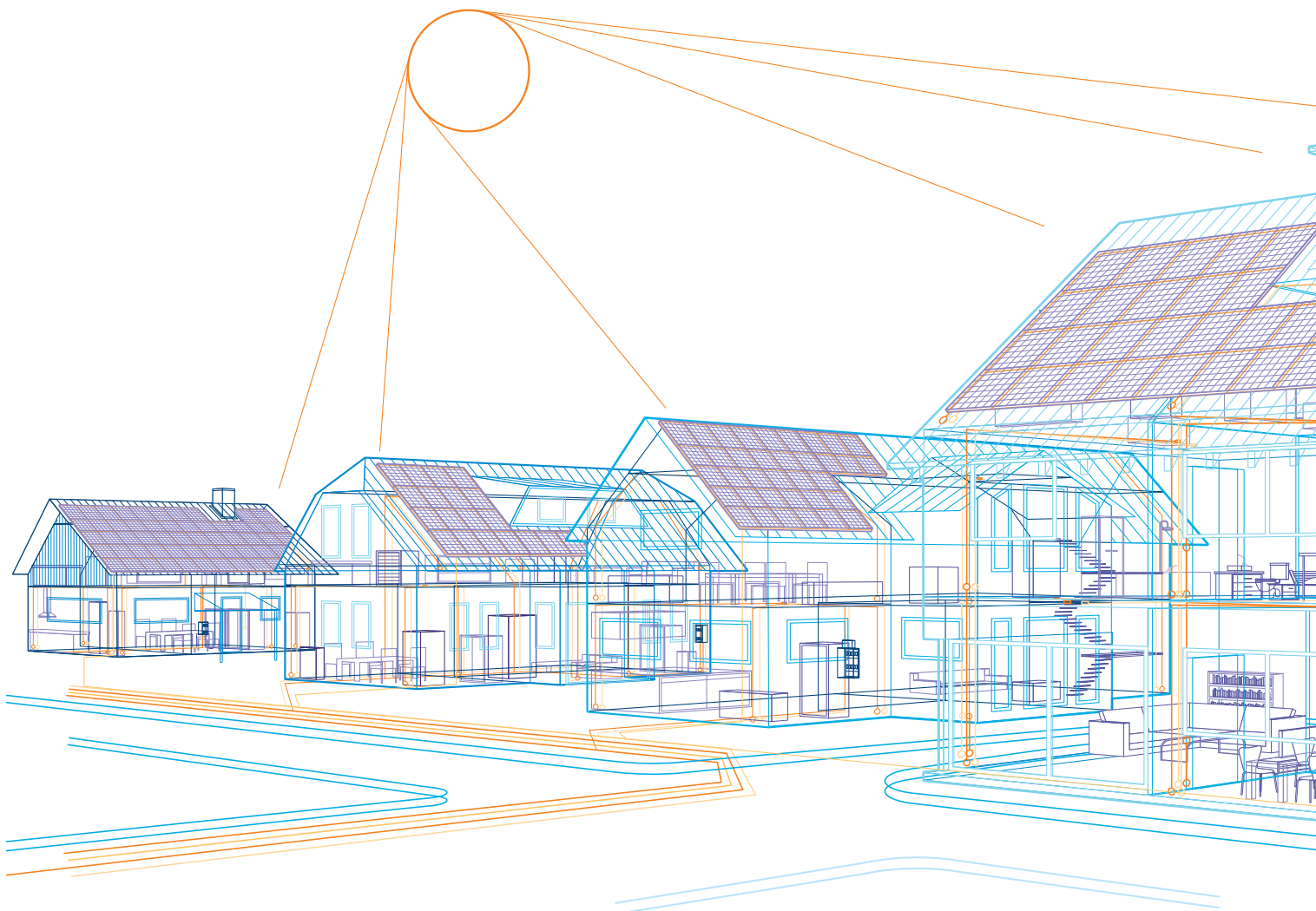
Safer roof photovoltaic systems

For residential, commercial and industrial applications

Every building can support the sustainable development by producing its own energy with photovoltaic panels. ABB contributes by making the process safer for people and installations.

Photovoltaic power systems enable businesses and homeowners to cut their energy bills by generating their own solar power with rooftop photovoltaic modules. ABB supports their efforts by helping to make the entire process of solar power generation in commercial, industrial and residential applications more efficient, cost effective and safe.

ABB offers a comprehensive range of inverters and low voltage products and systems that are designed specifically for the varying requirements of small, medium and large sized photovoltaic installations.



Complete portfolio of solar inverters

ABB offers a complete portfolio of solar inverters, from small transformerless single phase units to central inverters with a power rating of several hundred kilowatts. For large ground-mounted or flat-roof installations, ABB has developed the ABB megawatt station, a containerized electrical package including ABB central inverters, an optimized transformer, medium voltage switchgear, monitoring system and solar generator terminal boxes.

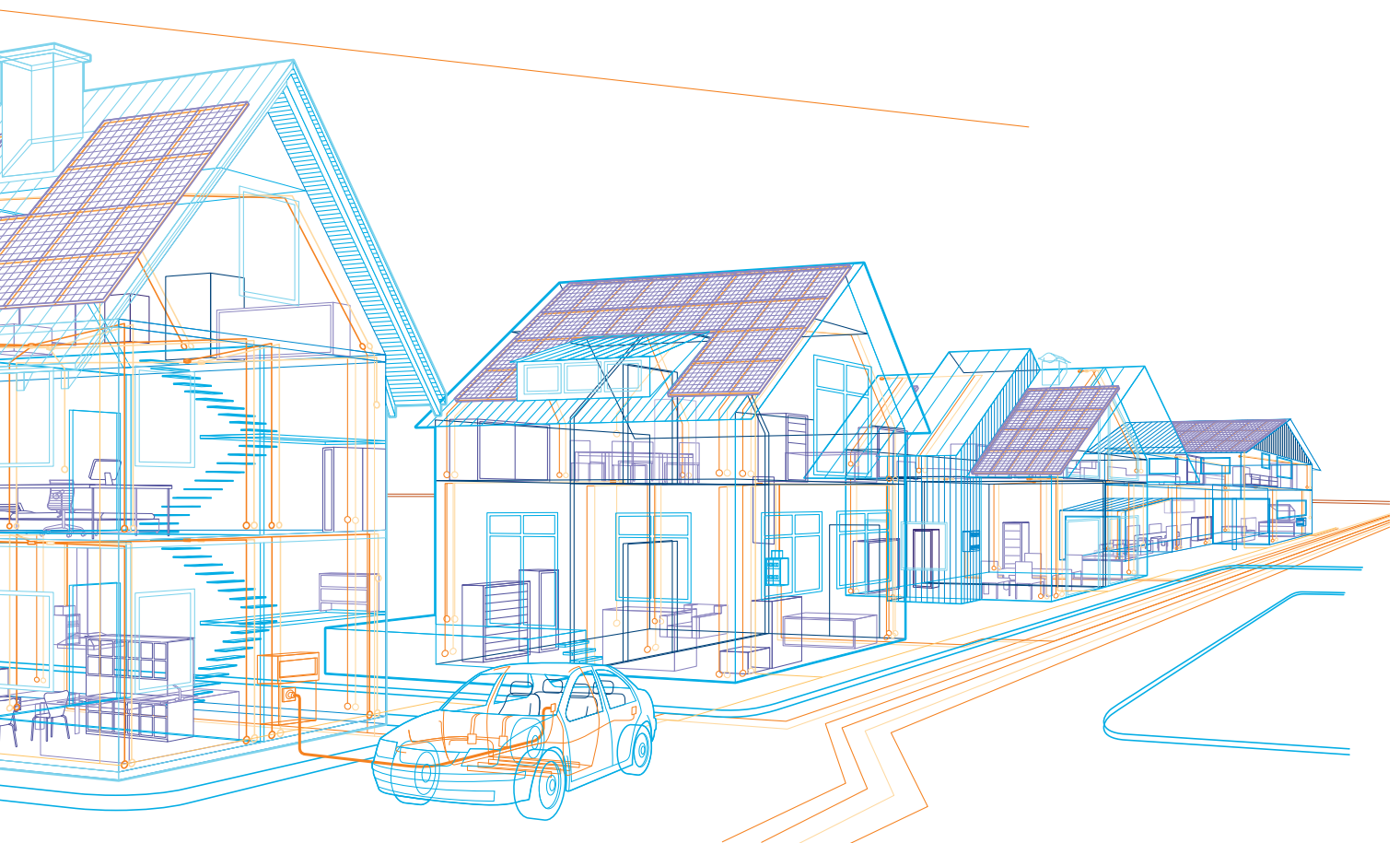
This extensive range of solar inverters meets the requirements of a diverse range of applications, from the smallest residential systems for single homes to multi-megawatt power plants. ABB's solar inverters feature local and remote connection options based on decades of expertise in protocols and standards used in industrial and building automation systems.

Low voltage products for reliability and safety

ABB offers a wide range of low voltage products that protect the inverters and electrical equipment from the potentially devastating effects of lightning and overvoltage.

Always ready to meet the demands of the market, ABB has developed a whole range of reliable products dedicated to photovoltaic applications, from the string on the DC side to the equipment that connects the installation to the AC power grid. These products include string boxes, miniature circuit breakers, switch disconnectors, residual current-operated circuit breakers, interface relays, energy meters, fuse disconnecting switches and fuses, surge arresters, consumer units and enclosures suitable for outdoor installation, all specially designed for photovoltaic applications.

ABB also provides a series of plug and play solutions like finished, wired and certified switchgear for a vast range of installations: from individual strings for domestic use to the low voltage equipment in a large photovoltaic power plant.



Manufacturing the solar panels

Achieving the full potential of future solar energy demand requires a considerable increase of production capacities and quality in solar industry which must be accompanied by a reduction in production costs.

ABB technologies and expertise play a major role in the solar power industry long before the solar modules are erected and the power plants and roof installations are in operation.

ABB robots and robot-based systems are used throughout the photovoltaic production process, bringing the highest levels of productivity, efficiency, quality and safety to all stages of solar module manufacturing.

And ABB electrical and automation products, systems and solutions are used to power and automate the factories and clean rooms that manufacture the solar modules and the silicon that is used to make the solar cells.

Robots and robot-based systems

ABB robots and robot-based systems are used throughout the photovoltaic production process. They handle the glass and solar modules, wash and dry the PV components, trim the laminate, solder the ribbons, assemble the components, and package and palletize the finished product – all with the highest levels of accuracy and in the shortest possible cycle times.

The key features and benefits of these solutions are attested by module manufacturers all over the world. They range from high speed handling and super-fast picking, short cycle times, precision and repeatability, the elimination of repetitive labor-intensive operations, worker safety, consistently high product quality, and a short return on investment.

Coordinated intelligent software, tailored training and exceptional field service all over the globe are part of the ABB robotics portfolio. With an installed base of more than 175,000 robots worldwide, ABB is a leading supplier of robots, robot-based manufacturing systems and service to the photovoltaic industry.

Power and automation solutions for photovoltaic production

ABB is a leading supplier of electrical and automation products, systems and solutions that help manufacturers in the solar power industry use energy efficiently and increase productivity in a sustainable way.

These products and systems include electrification systems that efficiently distribute power throughout production facilities, industrial substations that connect the site reliably to the power grid, high efficiency motors and variable speed drives that lower the energy consumption of machines, instrumentation and analyzers that actuate, measure, record and control process parameters, and distributed control systems that monitor and control the entire production process.

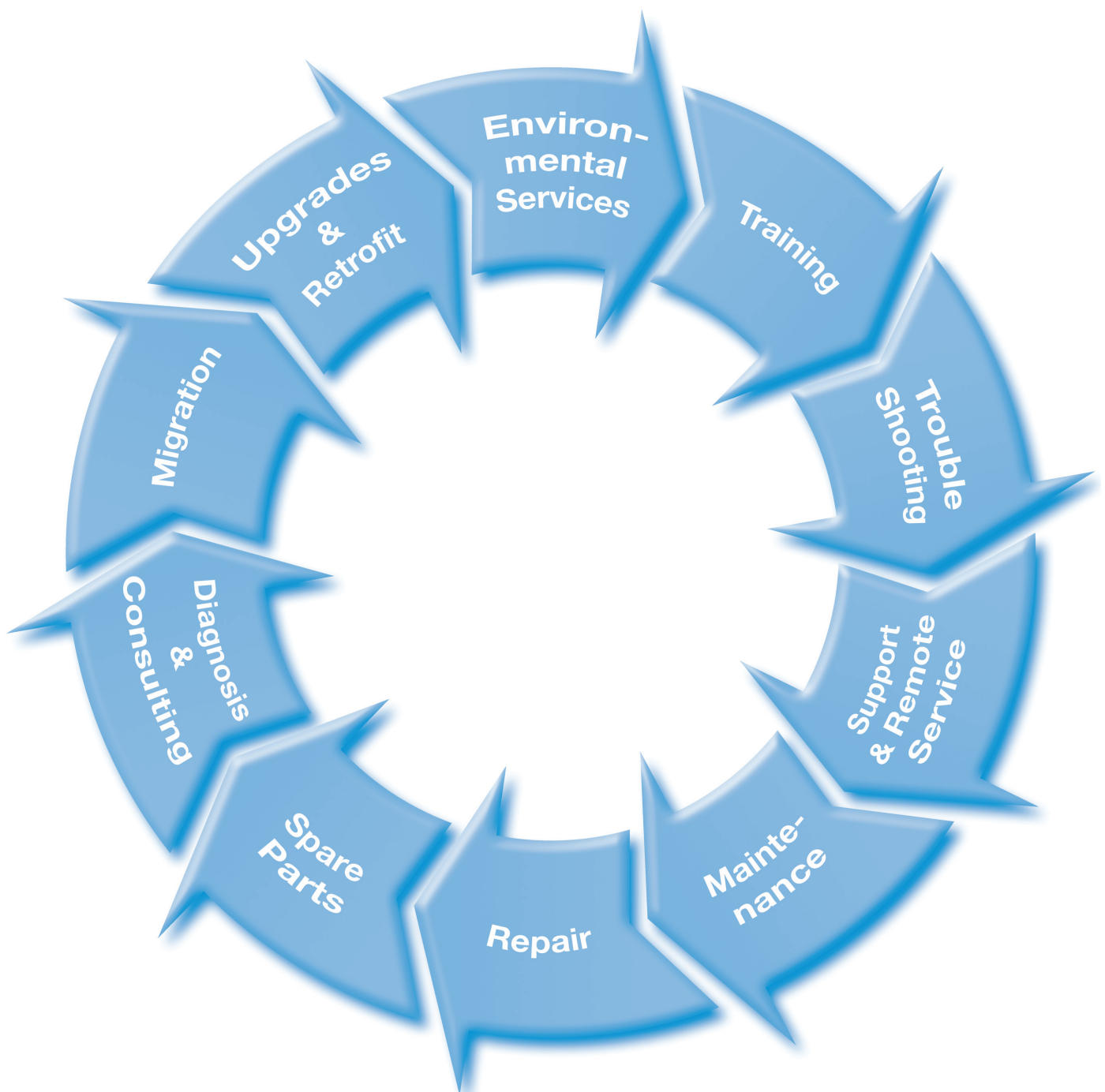


Global presence, local expertise

Lifecycle service for solar power applications

ABB supports its customers with a complete portfolio of lifecycle services to ensure the efficient and cost-effective operation of their solar power plants and photovoltaic assets. ABB's service portfolio is geared to provide customers with all the support they need across the entire field of lifecycle management – from troubleshooting, spare parts and equipment repair to training, remote monitoring and lifetime extension.

ABB service contracts are tailored to meet every customer need, they are available all over the world, and are supported by a strong network of local service resources.



Helping our customers achieve their targets

La Robla photovoltaic power plant, Spain

The solution is based on ABB's uniquely efficient concept for PV power plants, an approach that combines a high level of customization, rapid turnkey delivery and system optimization technologies that enable the plant to generate around 15 percent more energy than alternative designs. ABB completed delivery of the turnkey 13.3 megawatt photovoltaic plant within just four months of signing the contract. Project completion: 2010.

Hassi R'Mel integrated solar and combined cycle power plant, Algeria

ABB provided a complete electrical balance of plant (EBoP) solution for the 150 megawatt integrated solar and combined cycle power plant at the Hassi R'Mel gas field in northern Algeria. The plant is fired by a combination of natural gas and solar energy harnessed by parabolic troughs. ABB's ability to provide the full EBoP scope of supply – design, engineering, supply, erection and commissioning – and to equip the plant with its own brand of high-quality products, resulted in a more efficient workflow and shorter project execution time than would otherwise have been possible. ABB scope of supply also included power generators for gas turbines. Project completion: 2010.

ABB rooftop photovoltaic plant, Finland

Located on the rooftop of the ABB Drives factory in Helsinki, Finland, the installation is the largest solar power plant in the Nordic countries. The 181 kW plant generates about 160,000 kWh per year and benefits from the long summer days of its northern latitude. The ABB solution comprises ABB string inverters and one central inverter connected to the building automation system. Project completion: 2010.

eSolar thermo-solar plant, United States

The eSolar thermo-solar plant, using power tower system, counts with a control system completely designed, engineered and implemented by ABB. This system includes the supervisory control of the steam turbine and interface to patented eSolar heliostat farm control system. ABB also supplied a facet control solution that monitors and evenly distributes the solar light reflected by each of the farm's 24,000 dual-axis heliostats to maximize the performance and operating life of the two thermal receivers. Project completion 2009

Actelios photovoltaic power plants, Italy

ABB was selected by Actelios, part of the Italy-based Falck Group, to supply a turnkey solution for three photovoltaic power plants on the Italian island of Sicily. The solution utilized ABB's modular turnkey concept for PV plants to achieve fast delivery and high productivity. The three plants have a total capacity of more than 13 MW and supply around 19 gigawatt hours of renewable electric power a year; they avoid the generation of more than 9,400 tons of CO₂ annually. Project completion: 2010.

Saint-Gobain solar mirror production plant, Portugal

The Saint-Gobain plant in Covilis, Portugal, is the world's largest and most efficient production unit for tempered glass mirrors for solar thermal power plants. The plant is equipped with ABB robotics systems throughout the production process. The repeatability, precision, and reliability of the ABB robot-based systems ensure higher productivity, consistent product quality, and greater efficiency and safety on the production line. Project completion: 2009

1 La Robla, Spain | 2 ABB rooftop photovoltaic plant, Finland | 3 Saint-Gobain, Portugal | 4 Hassi R'Mel, Algeria
5 eSolar thermo-solar plant, United States



Taking solar power into the future

Smart grids, energy-efficient homes and long-distance solar power transmission

The global demand for electricity is growing faster than any other form of energy. At the same time, the generation of electric power is the largest single source of carbon dioxide emissions.

Part of the answer to this problem lies in the generation and integration of renewable and emission-free types of energy like solar power. ABB is at the forefront of this development – in smart grids, energy-efficient homes, and the transmission over long-distances of renewable energy.

Many of the technologies that are making this possible were pioneered by ABB.

Smart grids – the electrical system of the future

The smart grid of the future will have to meet four requirements: it will have to increase capacity, improve reliability, be more energy efficient, and integrate low carbon energy sources into the system.

Many of the technologies needed for the future electrical system are already well established, but need to be more widely applied. ABB, with its broad portfolio of power and automation products and systems, has pioneered many of these technologies and is already involved in numerous smart grid projects all over the world.

For instance, an award-winning ABB solution is helping Oncor, a leading U.S. power company to secure grid reliability in Dallas-Fort Worth, one of the country's largest metropolitan areas. The solution integrates large but unpredictable volumes of wind power into the Texas grid, reacts and heals grid disturbances in only 20 milliseconds, and saves almost one million megawatt-hours of energy and associated CO₂ emissions a year.

Desertec – the solar power supergrid

ABB and 11 other companies created the Desertec Industrial Initiative in 2009, the objective of which is to interconnect the power grids of Europe, the Middle East and North Africa, generate large amounts of electricity in the region's deserts and transport it to consumers via a solar power supergrid. Two technologies have been singled out by the Desertec Foundation as the most efficient and sustainable to generate and transport large volumes of electric power: high-voltage direct current (HVDC), a power transmission technology pioneered by ABB in the 1950s; and concentrating solar power (CSP) plants, a technology that ABB helped develop in the early 1990s.

CSP was selected by Desertec for its ability to produce a round-the-clock supply of power, by storing heat in molten salt and using it to generate electricity after sundown; and HVDC for its ability to transport electric power over distances of several thousand kilometers with exceptionally low power losses.

Energy-efficient solar-powered homes

ABB is involved in research and development projects with customers and universities all over the world to advance the frontiers of solar power technology.

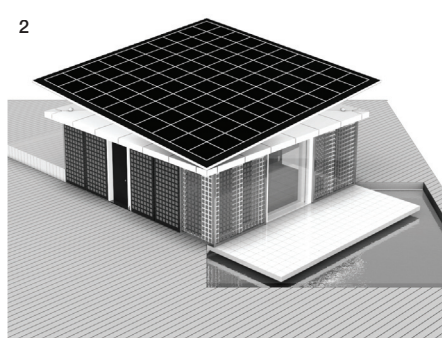
One example of many is a solar house built by students of the Technical University of Darmstadt, Germany, with help from ABB. The house won the 2009 U.S. Department of Energy's International Solar Decathlon competition in the United States for the most attractive, effective and energy-efficient sun-powered home.

The interior of the house is equipped entirely with ABB power distribution and building control products that convert the solar energy generated and then distribute it efficiently and sparingly throughout the house.

The criteria for the winning design were that the house should be affordable, attractive and easy to live in, and that it should produce as much or more energy than it consumes.

ABB also supported the Black and White project for Solar Decathlon 2010, built by students of the Polytechnics University of Madrid, by providing the electrical motors and low voltage components that allowed the roof to track as best as possible the sun movements and increase efficiency of the house.

1 Desertec Foundation. www.desertec.org | 2 Black and White house, Universidad Politécnica de Madrid.



Contact us

www.abb.com/solar

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